

Maine Geological Survey

Address: 22 State House Station, Augusta, Maine 04333
Telephone: 207-287-2801 **E-mail:** mgs@maine.gov
Home page: <http://www.maine.gov/doc/nrimc/nrimc.htm>

Explanation from Beach and Dune Geology Aerial Photos

Coastal Sand Dune Environments

DUNES

- D1 Frontal Dunes** - The most seaward ridge of sand in the sand dune system. The frontal dune may or may not be naturally vegetated with plants such as American beach grass (*Ammophila breviligulata*). The frontal dune may consist in part, or in whole, of artificial fill. In areas where smaller ridges of sand are forming in front of an established dune ridge, the frontal dune may include more than one ridge. Includes former frontal dune areas modified by development. Where the dune has been modified by structures, the dune position may be inferred from the present beach profile, dune positions along the shore, and regional trends in dune width.
- D2 Back Dunes** - Sand dunes or sand flats that lie landward of the frontal dune or a low-energy beach. Back dunes include those areas containing fill over back dune sand or over wetlands adjacent to the sand dune system.
- D3 Back Dune Washover Fan** - A small delta-like feature or fan that is built in a pond, on a salt marsh, or on a back dune when the sea breaches a frontal dune ridge and invades the landward side of the dunes during severe storms with high waves and tides.

BEACHES

- B1 Sand Beach** - An accumulation of sandy sediment that is defined on the landward side by the extent of storm wave action. Storm waves may also reach into the dunes at some locations. On this photo the seaward beach margin is arbitrarily placed offshore near the middle to low-tide position, although the area of wave influence extends farther seaward. Sand grains are less than 2 millimeters (0.08 inches) in diameter. The beach environment includes all berms, a temporary accumulation of sediment near the high-tide elevation.
- B2 Sand and Gravel Beach** - Beach consisting of a mixture of sand and gravel (greater than 2 mm, 0.08 in.). Commonly, the dominant grain size changes with either beach elevation or position along shore due to physical sorting by waves.
- B3 Gravel Beach** - Beach with most abundant grains greater than 2 mm, 0.08 in.).
- B4 Boulder Beach** - Gravel beach which includes boulders (greater than 25 cm, 10 in.).
- B5 Low-Energy Beach** - Beach sheltered from direct wave approach by land, extensive intertidal shoals, or coastal engineering structures. Low energy beaches contain a variety of grain sizes and are commonly found along tidal inlets adjacent to ocean-facing, high-energy beaches (B1-B4).

CHANNELS

- C1 Tidal Channel** - Subtidal and intertidal channels with varying water depths and currents influenced by the ebb and flood of tides.
- C2 Dredged Channel** - Tidal channel which has had sediment and/or rock removed from underwater locations in order to create a navigable channel or basin.
- C3 Channel Bar, Tidal Delta** - Sedimentary deposits of variable grain size in and adjacent to tidal channels. Flood-tidal deltas are common on the landward side of inlets in the sand dune system where the channel widens.
- C4 Supratidal Channel** - Channels above the high-tide line that lead to intertidal elevations. Supratidal channels carry freshwater flow and may be ephemeral.

COASTAL WETLANDS AND SHOALS

- M1 High Salt Marsh** - Tidal wetlands dominated by salt meadow hay (*Spartina patens*) which fringe the edges of estuaries. Sediments are predominantly a mix of mud, sand, and peat. The elevation of high salt marshes is approximately mean high water.
- M2 Low Salt Marsh** - Tidal wetlands dominated by saltwater cordgrass (*Spartina alterniflora*) which fringe the edges of estuaries. The elevation of low salt marshes ranges from mean sea level to mean high water. Sediments are predominantly mud and sand.
- M3 Freshwater Marsh** - Areas with hydric soils and water-tolerant vegetation which are frequently inundated or saturated by low salinity surface or ground water.
- P1 Freshwater Pond** - A natural body of standing fresh water occupying a small surface depression.
- L1 Ledge** - Intertidal and subtidal outcrops of resistant rock with little or no sediment cover

COASTAL ENGINEERING AND UPLANDS

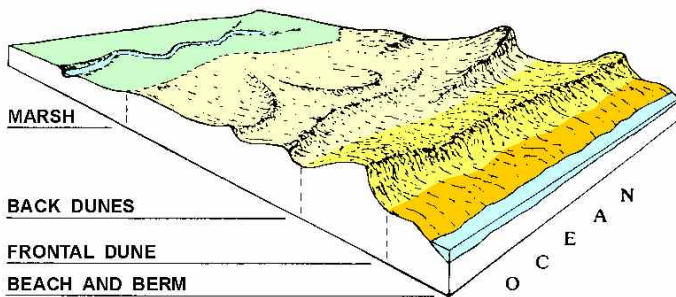
- H1 Coastal Engineering Structure/Fill** - Built structures such as jetties and bridges, some of which are located in the sand dune system.
- H2 Glacial/Bedrock Highlands** - Glacial sediment deposits or bedrock exposures that are generally elevated and stand above adjacent sand dune areas.

Note: Road names from U.S. Census Bureau TIGER/Line data. Please contact the Maine Geological Survey with any corrections.

Coastal Sand Dune Systems

COASTAL HAZARDS

Maine's stretches of sandy beach present an attractive place to live. The beauty of living on the coast, however, comes with built-in risks. In the photo at right, storm waves pound the beach at the base of two houses built on the frontal dune. In subsequent years, storms destroyed both of these houses. Erosion in this area has exceeded 80 feet since 1950 and is expected to continue. It is important to remember that the interplay of winds, waves, tides, and currents continually reshapes Maine's beach environments. Storm surges, sea-level rise, and inlet migration make coastal erosion a continuing process. Over time, the location and shape of today's beaches and dunes will continue to change. Although natural, this change can create a hazard to some coastal development.



COASTAL SAND DUNES

Sand dune systems are sand and gravel deposits within a marine beach system, including, but not limited to beach berms, frontal dunes, dune ridges, back dunes and other sand and gravel areas deposited by wave or wind action. Coastal sand dunes may extend into the coastal wetlands. The dune system includes areas which have been artificially covered by structures, lawns, roads, and fill. Sand dune systems also include all vegetation which is native to and occurring in the system. Building in Maine's sand dune system is regulated by the Coastal Sand Dune Rules.

COASTAL SAND DUNE RULES

The Maine Natural Resources Protection Act (NRPA: Title 38 M.R.S.A., Chapter 3, Section 480D, 2000) requires that new coastal development will not unreasonably (1) interfere with the natural supply or movement of sand within or to the sand dune system; (2) increase the erosion hazard to the sand dune system; (3) cause or increase the flooding of the dunes or adjacent properties; (4) interfere with the natural flow of any surface or subsurface waters; (5) inhibit the natural transfer of soil from the terrestrial to marine environments; (6) harm any significant wildlife habitat, threatened or endangered plant habitat, travel corridor, freshwater, estuarine or marine life; or (7) interfere with existing scenic, aesthetic, recreational, or navigational uses.

The Coastal Sand Dune Rules clarify the criteria for obtaining a permit under NRPA (in regard to coastal sand dune systems). The rules outline classes of projects which are exempt from the requirement of obtaining a permit. For all other projects, the rules outline standards which must be met to satisfy the statutory criteria.



USING COASTAL SAND DUNE PHOTOS

Permits are usually required for building projects located in Maine's coastal sand dune system. Such projects are described in the Coastal Sand Dune Rules of the Maine Department of Environmental Protection. The rules are based on the location of the project within the sand dune system.

These beach and dune geology photos delineate the dunes, beaches, channels, and wetlands that make up and border coastal sand dune environments. The boundaries shown on the photos provide guidance for interpreting the geology of the dune system with respect to the Coastal Sand Dune Rules. The location of the boundaries of the frontal dune (D1) and the back dune (D2) are especially important in the permit process.

Geologic environments delineated on these photos are based on 1986 aerial photographs and field work by the Maine Geological Survey. These photos are considered to be the best information available for showing existing conditions and location of frontal dunes and back dunes, unless an on-site survey indicates otherwise. Geologic boundary accuracy is \pm 3.5 meters (12 feet).

These photos may be revised as natural changes occur. Some coastal sand dunes have not been mapped. In these areas, refer to the definition of a sand dune system in the Sand Dune Rules to determine the applicability of the law. Coastal Marine Geologic Environments maps for the rest of the Maine coast are available from the Maine Geological Survey for areas not covered in this detailed photo series.

SOURCES AND ACKNOWLEDGMENTS

Geologic interpretation by Stephen M. Dickson based on field work and 1986 aerial photographs at a scale of 1:4,800. Information transferred to the photo bases by Jason N. Weist. Original interpretation of the geologic boundaries was carried out in 1990 to produce the Coastal Sand Dune Maps published by the Maine Geological Survey. The Coastal Sand Dune maps were peer reviewed by four coastal geologists and through two public workshops. Funding for the original mapping project was provided by the Maine Geological Survey, the Department of Environmental Protection and, in part, by the Maine Coastal Program with funds from the U.S. Department of Commerce, Office of Ocean and Coastal Resource Management as provided by the Coastal Zone Management Act of 1972, as amended.

HOW TO OBTAIN PRINTED COPIES

Printed copies of this photo and photos of other beaches may be purchased from the Maine Geological Survey, 22 State House Station, Augusta, ME 04333-0022 (207-287-2801).
E-mail: mgs@maine.gov.

ADDITIONAL SOURCES OF INFORMATION

Beach Processes

- Carter, R.W.G., 1988, Coastal environments: Academic Press, San Diego, California, 617 p.
Kaufman, W., and Pilkey, O., 1979, The beaches are moving: Anchor Press, Garden City, New York, 326 p.
Kelley, J.T., Kelley, A.R., and Pilkey, O.H., Sr., 1989, Living with the coast of Maine: Duke University Press, Durham, North Carolina, 174 p., (Available from the Maine Geological Survey).
Komar, P.D., 1998, Beach processes and sedimentation (2nd edition): Prentice-Hall, Upper Saddle River, New Jersey, 544 p.
National Research Council, 1995, Beach nourishment and protection: National Academy Press, Washington, D.C., 334 p.
Pugh, D.T., Tides, surges, and mean sea-level: John Wiley & Sons, New York, New York, 472 p.

Coastal Construction and Hazards

- Kelley, J.T., Kelley, A.R., and Pilkey, O.H., Sr., 1989, Living with the coast of Maine: Duke University Press, Durham, North Carolina, 174 p., (Available from the Maine Geological Survey).
Federal Emergency Management Agency, 2000, Coastal construction manual (3rd edition): Federal Emergency Management Agency (FEMA), 3 volumes.

Coastal Sand Dune Rules and Maine Natural Resources Protection Act

- Department of Environmental Protection, 1993, Coastal Sand Dune Rules - Chapter 355: Maine Department of Environmental Protection, Bureau of Land and Water Quality, 17 State House Station, Augusta, ME 04333-0017, 21 p.
Department of Environmental Protection, 2000, Natural Resources Protection Act (38 MRSA, Chap. 3, Secs. 480-A to 480-Z): Maine Department of Environmental Protection, Bureau of Land and Water Quality, 17 State House Station, Augusta, ME 04333-0017, 35 p.

Sea-Level Rise and Coastal Flooding

- Anticipatory planning for sea-level rise along the coast of Maine, 1994: Maine State Planning Office (38 State House Station, Augusta, Maine, 04333). Now available from U.S. Environmental Protection Agency.
Lyles, S.D., Hickman, L.E., Jr., Debaugh, H.A., Jr., 1988, Sea Level Variations for the United States, 1855-1986, U.S. Department of Commerce, Rockville, Maryland, 182 p.
State Planning Office, 2000, Maine floodplain management handbook: Maine State Planning Office, Augusta, Maine.

WWW Resources and Links

For a current listing of related links, visit the Maine Geological Survey web pages on Marine Geology and see our online Publications Catalog. The MGS web address is:

<http://www.state.me.us/doc/nrimc/mgs/mgs.htm>